

Assignment 4 – Report

Hash Function 1 Cycle Shift:

```
unsigned long FlightHASHTABLE::hashCode(string key)
{
    unsigned long hash = 0;
    for (int i = 0; i < key.length(); i++)
    {
        hash = (hash << 6) | (hash >> 27);
        hash += (unsigned long)(key[i]);
    }
    return hash % capacity;
}
```

Number Of Collisions on 1k file: 616

```
assignment — output — 80x24
[basilahmed@Basils-MacBook-Air assignment % ./output
-----
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions       :Print Number of Collisions
add                    :Add a new flight-ticket
delete <key>           :Delete a flight-ticket
find <key>             :Find a flight-ticket's details
allinday <date>        :Display all flight-tickets in a day
printASC <key>         :Print flight-tickets in ascending order
exit                  :Exit the program
import /Users/basilahmed/Documents/flight-ticket1k.csv
-----
990

-----
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions       :Print Number of Collisions
add                    :Add a new flight-ticket
delete <key>           :Delete a flight-ticket
find <key>             :Find a flight-ticket's details
allinday <date>        :Display all flight-tickets in a day

assignment — output — 80x24
-----
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export <path>           :Export flight-tickets to a CSV file
count_collisions       :Print Number of Collisions
add                    :Add a new flight-ticket
delete <key>           :Delete a flight-ticket
find <key>             :Find a flight-ticket's details
allinday <date>        :Display all flight-tickets in a day
printASC <key>         :Print flight-tickets in ascending order
exit                  :Exit the program
count_collisions
-----
616

-----
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions       :Print Number of Collisions
add                    :Add a new flight-ticket
delete <key>           :Delete a flight-ticket
find <key>             :Find a flight-ticket's details
allinday <date>        :Display all flight-tickets in a day
printASC <key>         :Print flight-tickets in ascending order
exit                  :Exit the program
```

Number Of Collisions on 10k file: 8955

```
assignment — output — 80x24

import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print Number of Collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                   :Exit the program
import /Users/basilahmed/Documents/flight-ticket10k.csv
-----
9922

-----
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print Number of Collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                   :Exit the program

```

```
assignment — output — 80x24

-----
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print Number of Collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                   :Exit the program
count_collisions
-----
8955

-----
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print Number of Collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                   :Exit the program

```

Number Of Collisions on 100k file: 98179

```
assignment — output — 80x24

import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print Number of Collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                   :Exit the program
import /Users/basilahmed/Documents/flight-ticket100k.csv
-----
99182

import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print Number of Collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                   :Exit the program
count_collisions
```

```
assignment — output — 80x24

import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print Number of Collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                   :Exit the program
count_collisions
-----
98179

import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print Number of Collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                   :Exit the program
```

Hash Function 2 Summation:

```
unsigned long FlightHASHTABLE::hashCode(string key)
{
    unsigned long hash = 0;
    for (int i = 0; i < key.length(); i++)
    {
        hash = hash + (int(key[i]));
    }
    return hash % capacity;
}
```


Number Of Collisions on 1k file: 606

```
assignment — output — 80x24

add                :Add a new flight-ticket
delete <key>       :Delete a flight-ticket
find <key>         :Find a flight-ticket's details
allinday <date>    :Display all flight-tickets in a day
printASC <key>     :Print flight-tickets in ascending order
exit              :Exit the program
import /Users/basilahmed/Documents/flight-ticket1k.csv
-----
990

import <path>      :Import flight-tickets from a CSV file
export <path>      :Export flight-tickets to a CSV file
count_collisions   :Print Number of Collisions
add               :Add a new flight-ticket
delete <key>       :Delete a flight-ticket
find <key>         :Find a flight-ticket's details
allinday <date>    :Display all flight-tickets in a day
printASC <key>     :Print flight-tickets in ascending order
exit              :Exit the program
count_collisions
-----
606
```

Number Of Collisions on 10k file: 9294

```
assignment — output — 80x24

count_collisions   :Print Number of Collisions
add               :Add a new flight-ticket
delete <key>       :Delete a flight-ticket
find <key>         :Find a flight-ticket's details
allinday <date>    :Display all flight-tickets in a day
printASC <key>     :Print flight-tickets in ascending order
exit              :Exit the program
import /Users/basilahmed/Documents/flight-ticket10k.csv
-----
9922

import <path>      :Import flight-tickets from a CSV file
export <path>      :Export flight-tickets to a CSV file
count_collisions   :Print Number of Collisions
add               :Add a new flight-ticket
delete <key>       :Delete a flight-ticket
find <key>         :Find a flight-ticket's details
allinday <date>    :Display all flight-tickets in a day
printASC <key>     :Print flight-tickets in ascending order
exit              :Exit the program
count_collisions
-----
9294
```

Number Of Collisions on 100k file: 98550

```
assignment — output — 80x24

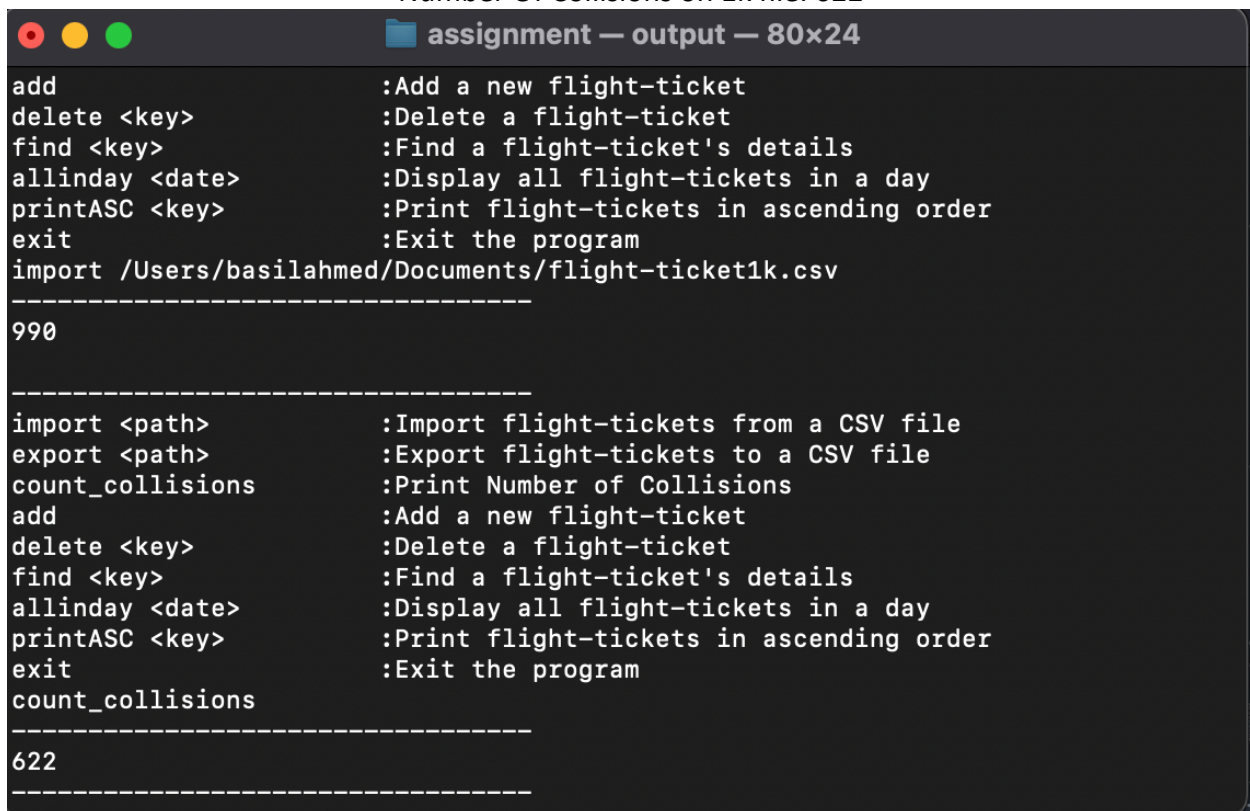
count_collisions      :Print Number of Collisions
add                   :Add a new flight-ticket
delete <key>          :Delete a flight-ticket
find <key>            :Find a flight-ticket's details
allinday <date>       :Display all flight-tickets in a day
printASC <key>        :Print flight-tickets in ascending order
exit                 :Exit the program
import /Users/basilahmed/Documents/flight-ticket100k.csv
-----
99182
-----

import <path>         :Import flight-tickets from a CSV file
export <path>         :Export flight-tickets to a CSV file
count_collisions      :Print Number of Collisions
add                   :Add a new flight-ticket
delete <key>          :Delete a flight-ticket
find <key>            :Find a flight-ticket's details
allinday <date>       :Display all flight-tickets in a day
printASC <key>        :Print flight-tickets in ascending order
exit                 :Exit the program
count_collisions
-----
98550
```

Hash Function 3 Polynomial:

```
unsigned long FlightHASHTABLE::hashCode(string key)
{
    unsigned long hash = 0;
    const int p = 37;
    long p_pow = 1;
    const int m = 1e9 + 7;
    int strLength = key.length();
    for (int i = 0; i < strLength; i++)
    {
        hash = (hash + (int(key[i] - 'a' + 1) * p)%m);
        p_pow = (p_pow * p) % m;
        hash = hash % capacity;
    }
    return hash;
}
```

Number Of Collisions on 1k file: 622



```
assignment — output — 80x24

add                :Add a new flight-ticket
delete <key>       :Delete a flight-ticket
find <key>         :Find a flight-ticket's details
allinday <date>    :Display all flight-tickets in a day
printASC <key>     :Print flight-tickets in ascending order
exit              :Exit the program
import /Users/basilahmed/Documents/flight-ticket1k.csv

-----
990

-----
import <path>      :Import flight-tickets from a CSV file
export <path>      :Export flight-tickets to a CSV file
count_collisions   :Print Number of Collisions
add                :Add a new flight-ticket
delete <key>       :Delete a flight-ticket
find <key>         :Find a flight-ticket's details
allinday <date>    :Display all flight-tickets in a day
printASC <key>     :Print flight-tickets in ascending order
exit              :Exit the program
count_collisions

-----
622
-----
```


Number Of Collisions on 10k file: 9562

```
assignment — output — 80x24

add                :Add a new flight-ticket
delete <key>       :Delete a flight-ticket
find <key>         :Find a flight-ticket's details
allinday <date>    :Display all flight-tickets in a day
printASC <key>     :Print flight-tickets in ascending order
exit              :Exit the program
import /Users/basilahmed/Documents/flight-ticket10k.csv
-----
9922
-----
import <path>      :Import flight-tickets from a CSV file
export <path>      :Export flight-tickets to a CSV file
count_collisions  :Print Number of Collisions
add               :Add a new flight-ticket
delete <key>       :Delete a flight-ticket
find <key>         :Find a flight-ticket's details
allinday <date>    :Display all flight-tickets in a day
printASC <key>     :Print flight-tickets in ascending order
exit             :Exit the program
count_collisions
-----
9562
-----
```

Number Of Collisions on 100k file: 98839

```
assignment — output — 80x24

count_collisions      :Print Number of Collisions
add                   :Add a new flight-ticket
delete <key>          :Delete a flight-ticket
find <key>            :Find a flight-ticket's details
allinday <date>       :Display all flight-tickets in a day
printASC <key>        :Print flight-tickets in ascending order
exit                 :Exit the program
import /Users/basilahmed/Documents/flight-ticket100k.csv
-----
99182

-----
import <path>         :Import flight-tickets from a CSV file
export <path>         :Export flight-tickets to a CSV file
count_collisions      :Print Number of Collisions
add                   :Add a new flight-ticket
delete <key>          :Delete a flight-ticket
find <key>            :Find a flight-ticket's details
allinday <date>       :Display all flight-tickets in a day
printASC <key>        :Print flight-tickets in ascending order
exit                 :Exit the program
count_collisions
-----
98839
```

The Average Collisions for all 3 files for Hash Code 1 is 35,916. For Hash Code 2, it is 36,150. Lastly, for Hash Code 3, the average number of collisions is 36,341.

Hence, comparing the average number of collisions **Hash Code 1/Cycle Shift proved to be the best Hash Code out of all 3.**